surface of a conventional keyboard, for example, the peripheral surface around hard keys of the keyboard.

[0038] In a second embodiment, **FIG. 2D** shows a cross-sectional view of the three microchambers, with microchambers **205** and **215** each configured to have a first height, and microchamber **210** configured to have a second height that is less than the first height. In this second embodiment, microchamber **210** constitutes one of a group of microchambers that collectively constitute a recessed emulated hard key, while microchambers **205** and **215** constitute two of a group of microchambers that collectively constitute an inactive surface of the reconfigurable keyboard.

[0039] Various combinations of the above-described features will be used in various embodiments. For example, various groups of microchambers can be configured to be in one of three, rather than two, alternative positions: up (convex), flat, and down (concave). The up position denotes a raised emulated hard key, the down position a recessed emulated hard key, and the flat position the inactive surface of the reconfigurable keyboard. In a first embodiment, both the raised and recessed emulated hard keys are used for hard key functions, while in a second embodiment, the recessed emulated hard keys provide a place-holder functionality that makes it easier for the user's fingertips to locate functional raised emulated hard keys.

[0040] Several alternative systems and methods can be employed to implement the emulated hard keys using the microchambers shown in **FIGS. 2A, 2B**, 2C, and 2D. In a first exemplary embodiment, microchambers **205**, **210**, and **215** have ports **221**, **222**, and **223** respectively located at their bases. The ports are connected to a manifold **244** that carries air to the microchambers. Air is injected or removed from microchamber **210** via port **222** thereby raising or lowering, respectively, the upper surface **211** of microchamber **210** and configuring microchamber **210** as one microchamber of a group of microchambers that constitute a raised or recessed, respectively, emulated hard key.

[0041] The upper surface **211** of microchamber **210** constitutes one portion of the keypad surface associated with reconfigurable keyboard **110**. Microchamber **210** can be subsequently reconfigured to constitute the inactive surface of the reconfigurable keyboard by removing or injecting air via port **222**.

[0042] Referring back to **FIGS. 2C and 2D**, bi-stable valves **241**, **242**, and **243** are optionally incorporated into each of the various ports. In a first position, each of the bi-stable valves allows air to flow from manifold **244** into the associated microchamber, and in a second position prevents air from exiting the microchamber. The bi-stable valves are operated sequentially, to allow a common air supply to configure each of the microchambers individually, thereby reducing the peak load on the common air supply. The bi-stable valves draw negligible current from an electrical source when in an inactive state, thereby reducing the electrical requirements for operating the reconfigurable keyboard.

[0043] Additionally, a pressure sensor (not shown) may be incorporated into each of the microchambers. The pressure sensor detects application of finger pressure upon the raised portion of the microchamber. This aspect will be explained in more detail below using other figures.

[0044] One or more of the features mentioned above may be optionally incorporated into one or more alternative embodiments that are described below.

[0045] In an alternative exemplary embodiment, a fluid, such as a liquid, a gel, an inert gas, or a viscous liquid is used to change the height of microchamber **210**. Here again, ports **221**, **222**, and **223** are employed to carry out this operation.

[0046] In another alternative exemplary embodiment, each of the microchambers is filled with an electrogel. The amount of electrogel introduced into, and removed from, each microchamber, is controlled to provide either the first height or the second height of the microchamber.

[0047] In yet another alternative exemplary embodiment, each microchamber contains a piezo-electric material that changes its dimension when a voltage is applied to the material. The change in dimension can be used to increase or decrease the height of the micro chamber.

[0048] **FIGS. 2A, 2B**, 2C, and 2D will now be described in more detail. Firstly, while ports **221**, **222**, and **223** are shown located at the bottom of each microchamber, such ports can be located at other convenient locations with reference to each microchamber.

[0049] Secondly, each microchamber is illustrated as having a cubic shape. This has been done merely for purposes of explanation, and alternative embodiments will have other shapes such as cylindrical, rhomboidal, and oval shapes.

[0050] **FIGS. 3A and 3B** illustrate a first example of an array **200** of microchambers configured as a telephone keypad **300**. In this exemplary embodiment each of the 12 keys of a conventional telephone keypad has been emulated by raising the top surfaces of each of **16** adjacent microchambers to form a raised, square keypad corresponding to each of the telephone keys. For example, the telephone key with numeral "7"**340** has been emulated by activating a 4×4 array of adjacent microchambers.

[0051] **FIG. 3B** provides a cross-sectional view of keypad **300**. Keypad **300** is composed of an array **200** of microchambers upon which is superimposed a flexible display screen **320**. Raised surface **317** corresponds to the raised keypad of numeral "7," and numeric display **316** corresponds to the label "7." Unraised surface **318**, below which is located inactive microchambers, constitutes the inactive surface of keypad **300**.

[0052] Display screen **320** typically comprises a flexible sheet of material. In one exemplary embodiment, display screen **320** is a flexible touch-pad coupled to a suitable display driver (not shown). The display screen displays characters, such as the label "7," at appropriate locations on the touch-pad depending upon the nature of the emulated keyboard. Consequently, while the label "7" is displayed in alignment with raised surface **317** for emulating the telephone keypad, display **320** can also be further used to display, at the same location, or elsewhere, alphanumeric characters associated with a QWERTY keyboard when such a keyboard is emulated by array **200**.

[0053] In an alternative exemplary embodiment, display screen **320** is located underneath array **200**. In such an embodiment, the material of microchambers of array **200** is transparent, so that the labels displayed by the display screen are visible to the user of the keyboard.